

**REMARKS**

By the present amendment, independent claims 1 and 10 have been amended. Thus, after the present amendment, claims 1-5, 7-13, 15-18 and 28-31 remain in the present application. Reconsideration and allowance of pending claims 1-5, 7-13, 15-18 and 28-31 in view of the above amendments and following remarks are requested.

**A. Rejection of Claims 1 and 10 Under 35 USC §112, ¶ 1**

The Examiner has rejected independent claims 1 and 10 under 35 USC §112, first paragraph. Applicants submit that amended independent claims 1 and 10 overcome the Examiner's rejection.

**B. Rejection of Claims 1 and 10 Under 35 USC §112, ¶ 2**

The Examiner has also rejected independent claims 1 and 10 under 35 USC §112, second paragraph. Applicants submit that amended independent claims 1 and 10 overcome this Examiner's rejection.

**C. Rejections of Claims 1-3, 7, 10-11, 15-16, 28, and 30 under 35 USC §103**

The Examiner has rejected claims 1-3, 7, 10-11, 15-16, 28, and 30 under 35 USC §103(a) as being unpatentable over U.S. Patent 5,120,572 to Kumar (hereinafter "Kumar") in view of U.S. Patent 6,117,789 to Lee (hereinafter "Lee"). For the reasons discussed below, Applicants respectfully submit that the present invention, as defined by amended independent claims 1 and 10, is patentably distinguishable over Kumar and Lee.

Kumar is directed to overcoming performance limitations of multi-chip modules (MCM) where a high density multi-layer interconnect (HDMI) "substrate" is used to

interconnect a large number of integrated circuits. According to Kumar, increasing the operating frequency of the MCMs and proper termination of “low loss copper lines” in order to avoid signal distortion and other undesirable outcomes are desired goals. Thus, Kumar discloses termination resistors, as well as decoupling capacitors, for use in a HDMI supporting a number of integrated circuit devices which together form a MCM. See, for example, Abstract of Kumar, and column 1, lines 12-31. Thus, Kumar is directed to formation of termination resistors and decoupling capacitors in a substrate consisting multiple layers, as known in the MCM art. Indeed, according to Kumar, “preferably, the integrated resistors and capacitors are fabricated in substrates made from copper/polyimide technology.” Kumar, column 1, lines 40-42 (emphasis added). The “copper/polyimide technology” is directed to fabrication of components, such as resistors, on an MCM board (or a PC board), and not to fabrication of resistors within the semiconductor chip itself.

Therefore, fundamentally, Kumar is not directed to fabrication of high resistivity resistors in silicon wafers and substrates, but Kumar’s “substrate” is one level removed from the silicon substrate of the present invention, in that Kumar’s “substrate” is a MCM board which supports a number of silicon substrates, such as those subject of the present invention. Applicants have amended independent claims 1 and 10 to specifically recite that the invention’s resistor is fabricated in a semiconductor substrate.

An attempt to analogize Kumar to the present invention would not be successful due to the fundamental differences in the technologies, goals, and results of Kumar and

the present invention. For example, the Examiner has stated that "a first interconnect metal layer" required by the claims of the present invention is analogous to layer 40 described in Kumar. However, Kumar discloses "substrate 40" as being "similar to those described in connection with substrate 10." Kumar, column 4, lines 26-28. But, Kumar states that substrate 10 is made of "any suitable material so long as it is of high enough resistance so as not to short an applied resistor. The substrate may be made of silicon, alumina, sapphire, aluminum nitride, silicon carbide or boron nitride." Kumar, column 2, lines 59-63. Thus, while according to the present invention, the first interconnect layer is a conventional metal interconnect within a semiconductor substrate, if Kumar were used to as an analogy, the interconnect metal need in fact be of "high enough resistance," such as "silicon, alumina, sapphire, aluminum nitride, silicon carbide or boron nitride." Thus, Kumar's "substrate 40" in Figure 30 (i.e. "substrate 10" in Figure 1), is not the same or even nearly the same as the invention's interconnect metal layer. Fundamental differences such as this, result in a number of other differences with the present invention, as discussed below.

For example, the Examiner states that the "first intermetallic dielectric layer" of the present invention is disclosed as the thin insulating material over the Kumar's "first interconnect layer" (i.e. over Kumar's substrate 40). A "thin layer of an insulating material" is to be "applied to a metal substrate which could be organic, such as polyimide, or inorganic, such as aluminum nitride, diamond, or aluminum oxide. These materials allow heat generated from the resistors to be efficiently removed from the substrate."

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Kumar, column 2, line 67 to column 3, line 3. Thus, this "thin layer of an insulating material" is not analogous to an interlayer dielectric that is formed between two interconnect metal layers. Indeed, "resistor 48" is shown as fabricated directly on "substrate 40" in all the relevant drawings of Kumar. In fact, since the substrate in Kumar is contemplated to be primarily insulative (and for that reason is not analogous to the interconnect metal layer required by the present invention), "resistor 48" can be, and is, fabricated directly on substrate 40, and not on an interlayer dielectric as required by the present invention. For all the foregoing reasons, the present invention, as claimed by amended independent claims 1 and 10 is patentably distinguishable over Kumar.

Furthermore, in contrast to the present invention as defined by amended independent claims 1 and 10, Lee is directed to a reduced-cost method of manufacturing a thin film resistor layer exhibiting efficient electrical operation. The Examiner acknowledges that Lee does not disclose a first interconnect metal layer. Moreover, Lee does not disclose, teach, or suggest a second interconnect metal layer built over the first interconnect metal layer. Thus, Lee does not teach the advantages inherent in the claimed configuration. Furthermore, there is no teaching or suggestion to combine Kumar with Lee. Therefore, Kumar, singly or in combination with Lee, does not disclose, teach, or suggest the present invention as defined by amended independent claims 1 and 10.

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**D. Rejections of Claims 4-5, 8-9, 12-13, and 17-18 under 35 USC §103**

The Examiner has rejected claims 4-5, 8-9, 12-13, and 17-18 under 35 USC §103(a) as being unpatentable over Kumar and Lee as applied to claims 1 and 10, and further in view of U.S. Patent 6,627,539 to Zhao et al. (hereinafter "Zhao"). Applicants respectfully submit that claims 4-5, 8-9, 12-13, and 17-18 depend from amended independent claims 1 and 10 and, thus, claims 4-5, 8-9, 12-13, and 17-18 should be allowed at least for the same reasons discussed above in conjunction with patentability of amended independent claims 1 and 10.

**E. Rejections of Claims 29 and 31 under 35 USC §103**

The Examiner has rejected claims 29 and 31 under 35 USC §103(a) as being unpatentable over Kumar and Lee as applied to claims 1 and 10, and further in view of U.S. Patent 5,422,307 to Ishii (hereinafter "Ishii"). Applicants respectfully submit that claims 29 and 31 depend, respectively, from amended independent claims 1 and 10 and, thus, claims 29 and 31 should be allowed at least for the same reasons discussed above in conjunction with patentability of amended independent claims 1 and 10.

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**F. Conclusion**


Based on the foregoing reasons, the present invention, as defined by amended independent claims 1 and 10 and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early Notice of Allowance directed to all claims 1-5, 7-13, 15-18, and 28-31 remaining in the present application is respectfully requested.

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Respectfully Submitted,  
FARJAMI & FARJAMI LLP

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FARJAMI & FARJAMI LLP  
26522 La Alameda Ave., Suite 360  
Mission Viejo, California 92691  
Telephone: (949) 282-1000  
Facsimile: (949) 282-1002

  
Michael Farjami, Esq.  
Reg. No. 38,135

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